

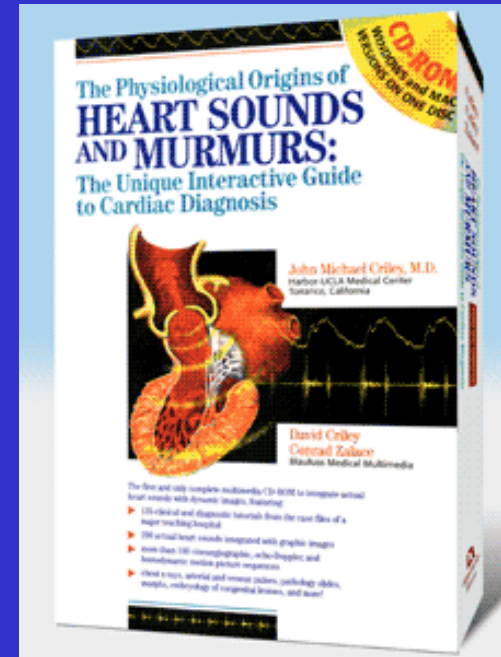
# Introduction to Cardiac Auscultation

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# Overview of Module

- Today's lecture
  - review of valve disease
    - Aortic stenosis
    - Aortic regurgitation
    - Mitral stenosis
    - Mitral regurgitation
- Lecture
  - 9 hours of auscultation
  - review sessions as desired by class
- Rest of your life
  - practice, practice, practice
  - **NEW!!!** Criley CD now available through internet  
[www.blaufuss.net/USUHS/tutorial/](http://www.blaufuss.net/USUHS/tutorial/)



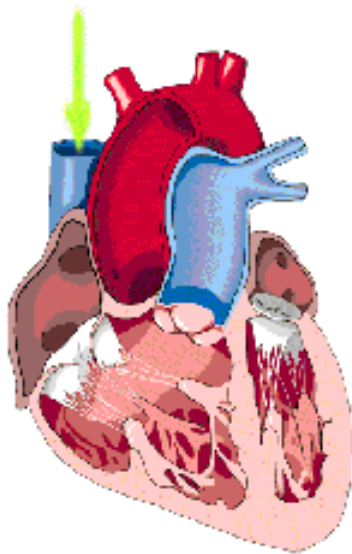
# Deliberate Practice

- Achieving mastery of a skill requires deliberate practice
- Michael Jordan threw 500 free throws every day on top of playing
- 4/10 rule
  - It takes 4 hours practice per day over ten years to achieve mastery of a skill

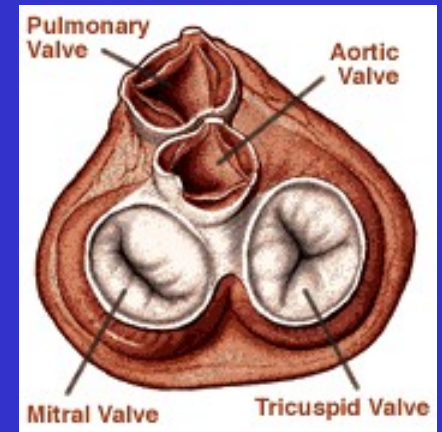


# Normal Valve Function

- Prevent backward flow of blood
- Permit forward flow of blood



- **Right Atrium**
- **Tricuspid Valve**
- **Right Ventricle**
- **Pulmonic Valve**
- **Pulmonary Arteries**
- **Pulmonic Veins**
- **Left Atrium**
- **Mitral Valve**
- **Left Ventricle**
- **Aortic Valve**
- **Aorta**



# Abnormal valve function

- Allows backward flow
  - valve is “leaky;” “regurgitant;” “incompetent”
- **Reduces cardiac output while increasing workload**
  - results in inefficient pumping; greater volume of blood needs to be pumped with each beat to maintain cardiac output
  - “volume load”
  - Typically causes dilatation of the cardiac chamber
  - Backwards jet causes turbulence that is audible as murmur



# Abnormal valve function

- Prevents forward flow
  - valve does not open well
  - Greek stenōsis, a narrowing
- **Reduces cardiac output while increasing workload**
  - Heart must develop more pressure to move blood
  - “pressure load”
  - usually results in hypertrophy of proximal (“upstream”) chamber (LA in MS, LV in AS)
  - acceleration of blood through tight valve causes turbulence that is audible as a murmur

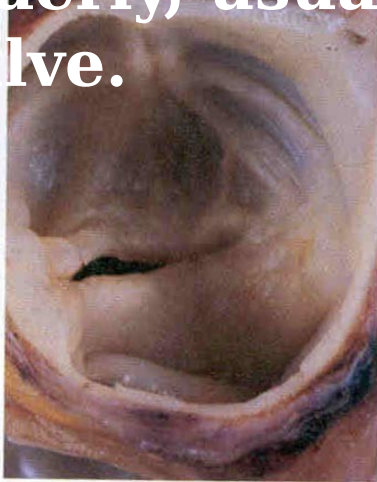


# Valvular Aortic Stenosis

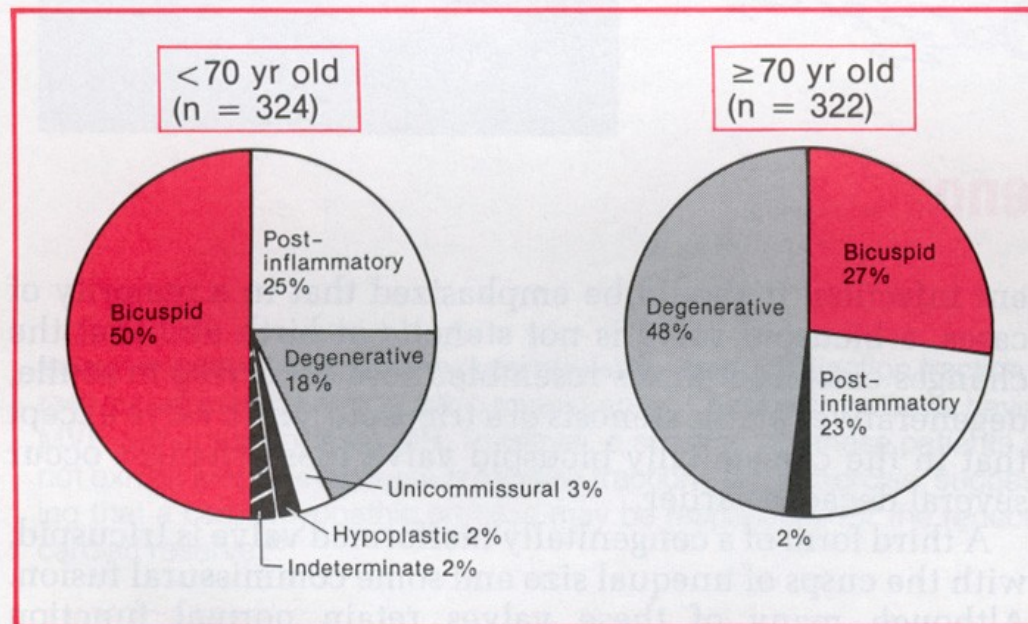
- failure of valve to open normally during systole, requiring LV to develop excess pressure to overcome increased resistance
- pressure gradient between LV and aorta may be as much as 100 mm Hg
- causes concentric hypertrophy
- symptoms of exertional chest pain, syncope, dyspnea
  - mandate valve replacement to prevent sudden death



**Aortic stenosis due to bicuspid valve.**  
**Symptomatic AS in young usually due to**  
**congenitally abnormal valve or (less**  
**frequently in US) rheumatic disease. In**  
**elderly, usually due to calcification of the**  
**valve.**



**Fig. 29-24 Aortic stenosis.** Mild stenosis in valve leaflets of a young adult. (From Damjanov I, Linder J, editors: *Anderson's pathology*, ed 10, vol 1, St Louis, 1996, Mosby.)

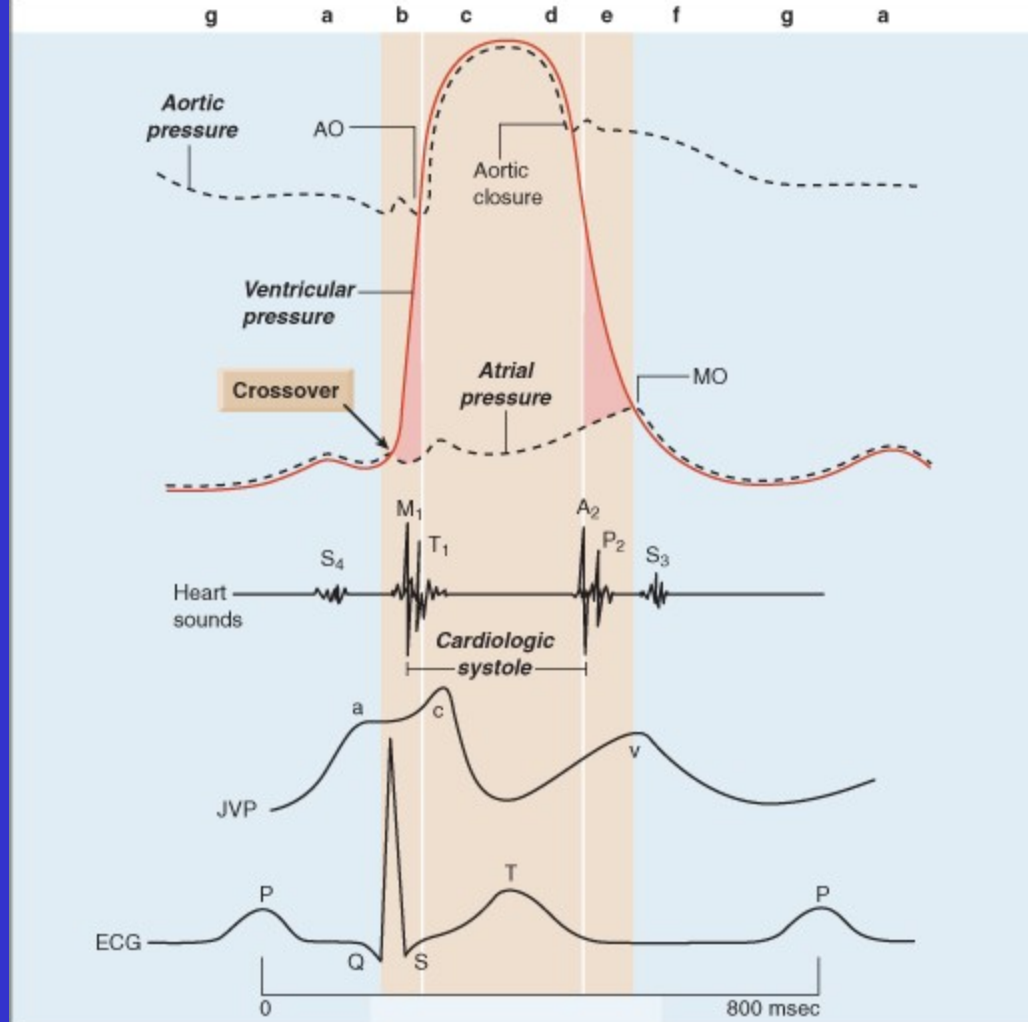




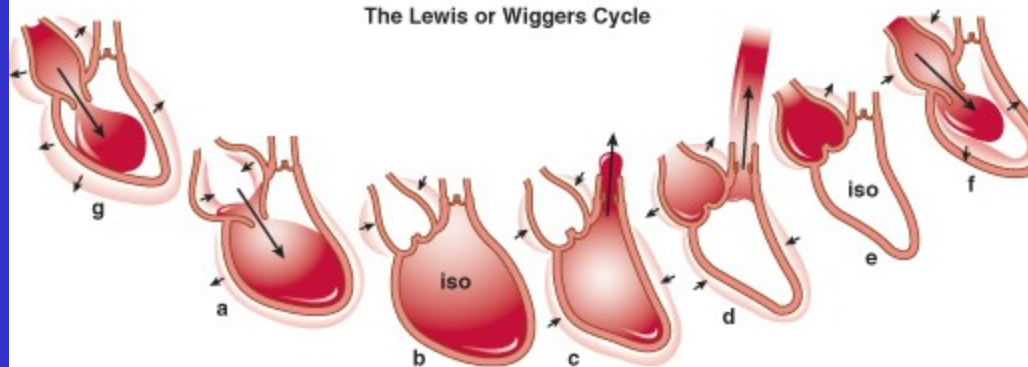
# Grades of AS

- Normal valve area 3-4 cm<sup>2</sup>
- Mild AS >1.5 cm<sup>2</sup>
- Moderate >1.0 cm<sup>2</sup>
- Severe AS when area  $\frac{1}{4}$  normal
  - <1 cm<sup>2</sup> for large person
  - <0.75 cm<sup>2</sup> for normal person



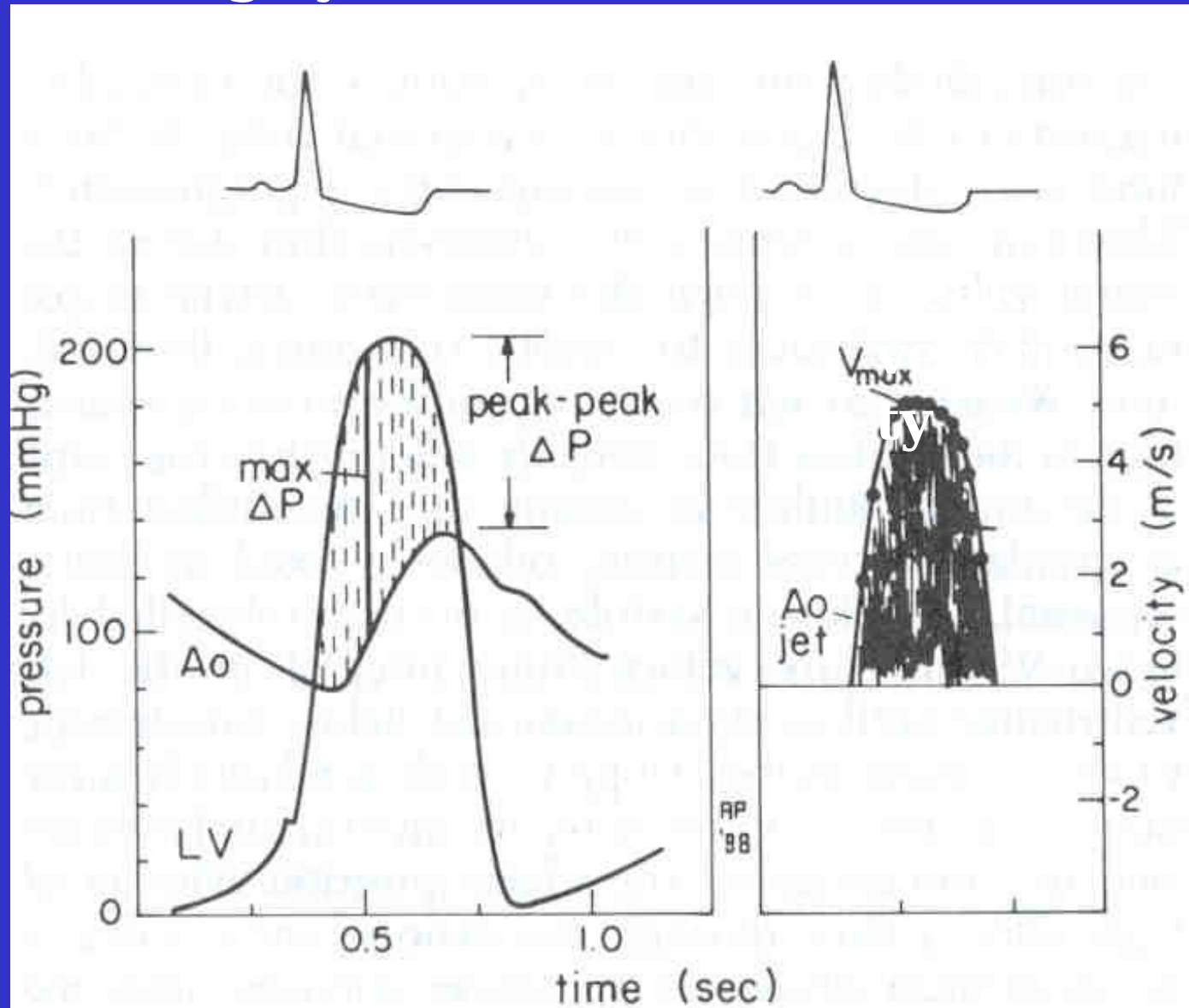


The Lewis or Wiggers Cycle

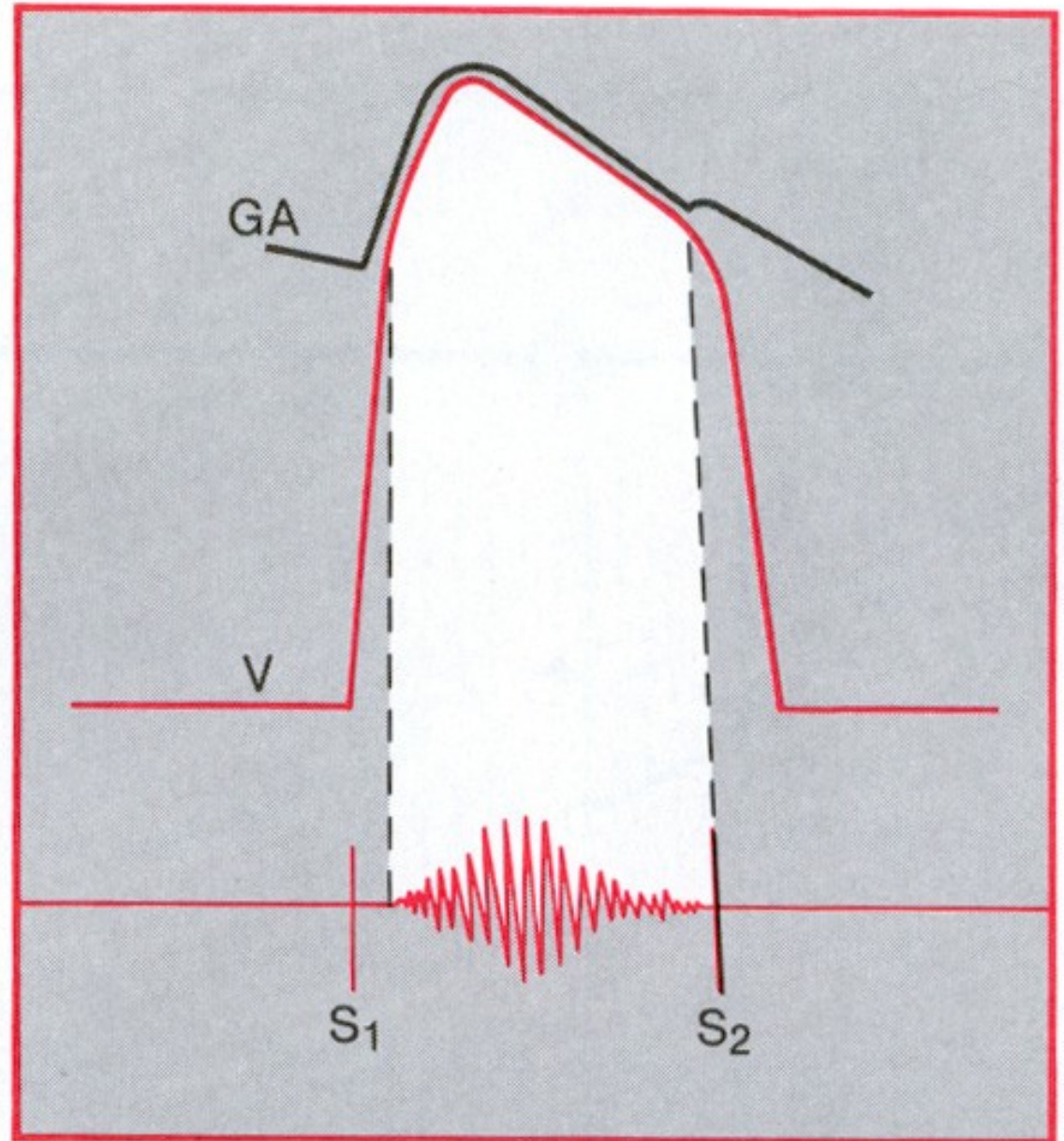


# Pressure gradient develops between LV and Aorta during systole in AS

Note  
delayed  
upstroke of  
aortic  
pressure;  
murmur  
peaks with  
max  
pressure  
gradient  
due- equals  
time of  
greatest  
blood  
velocity



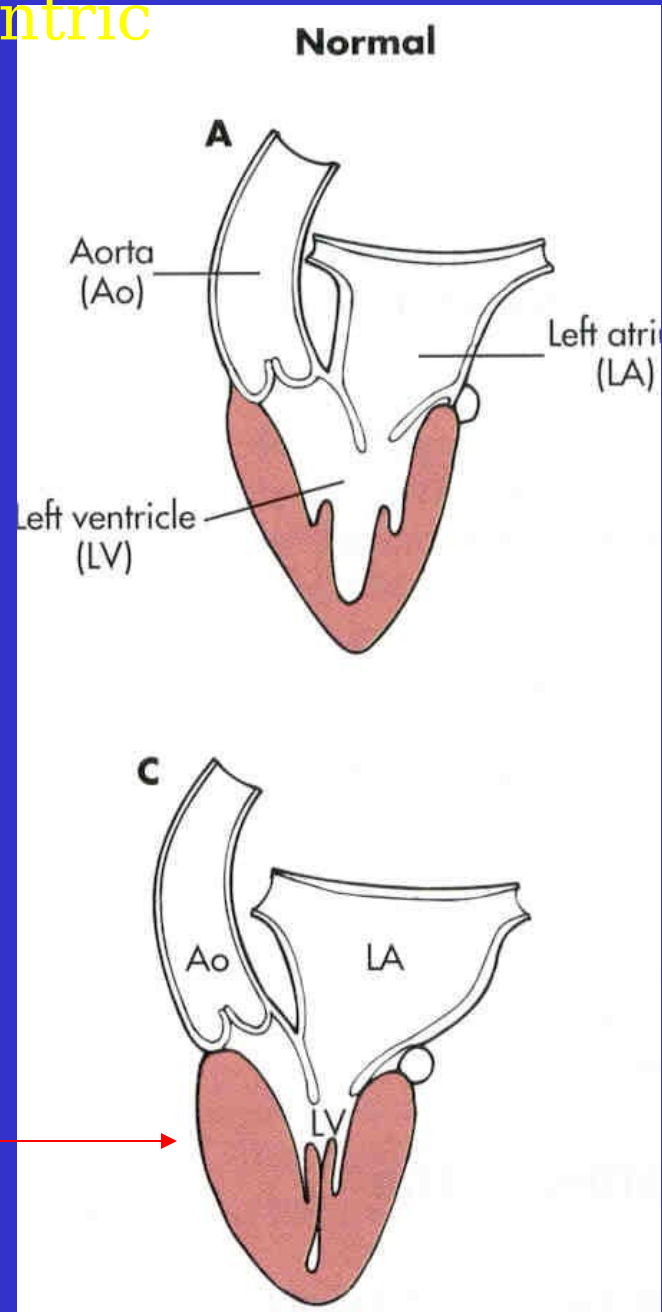
**Murmur in AS is mid-systolic, crescendo-decrescendo. Note that it begins AFTER S1 and ends BEFORE S2**



# Pressure load causes concentric hypertrophy

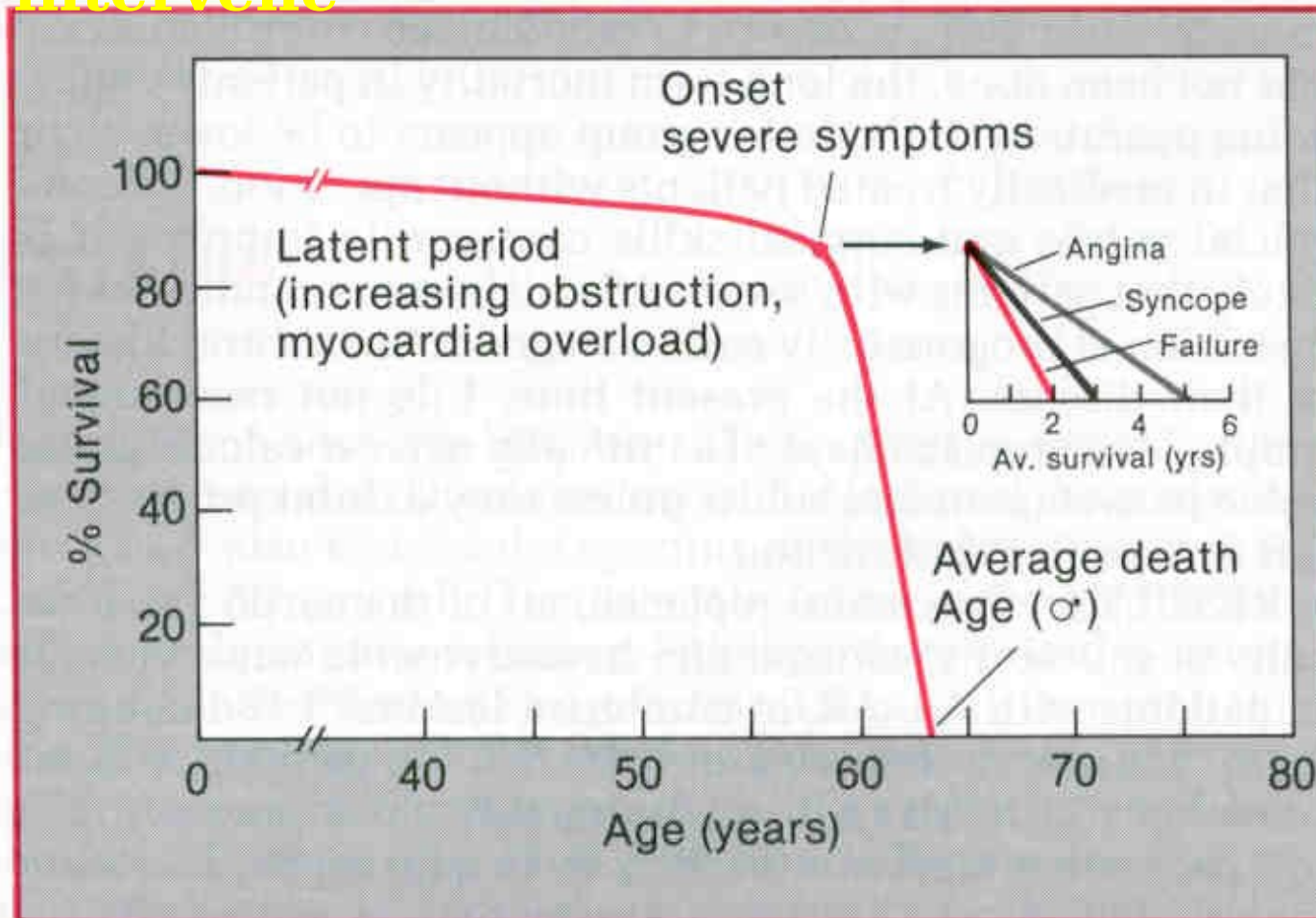
Comparison of cross section of normal left heart with heart showing concentric left ventricular hypertrophy. Note reduced chamber size, thickened walls, enlarged left atrium.

**Concentric hypertrophy**





# Rapid fall in survival once symptoms intervene



**FIGURE 34-27.** Natural history of aortic stenosis without operative treatment. (From Ross, J., Jr., and Braunwald, E.: Aortic stenosis. *Circulation* 38[Suppl. V]:61, 1968, by permission of the American Heart Association, Inc.)

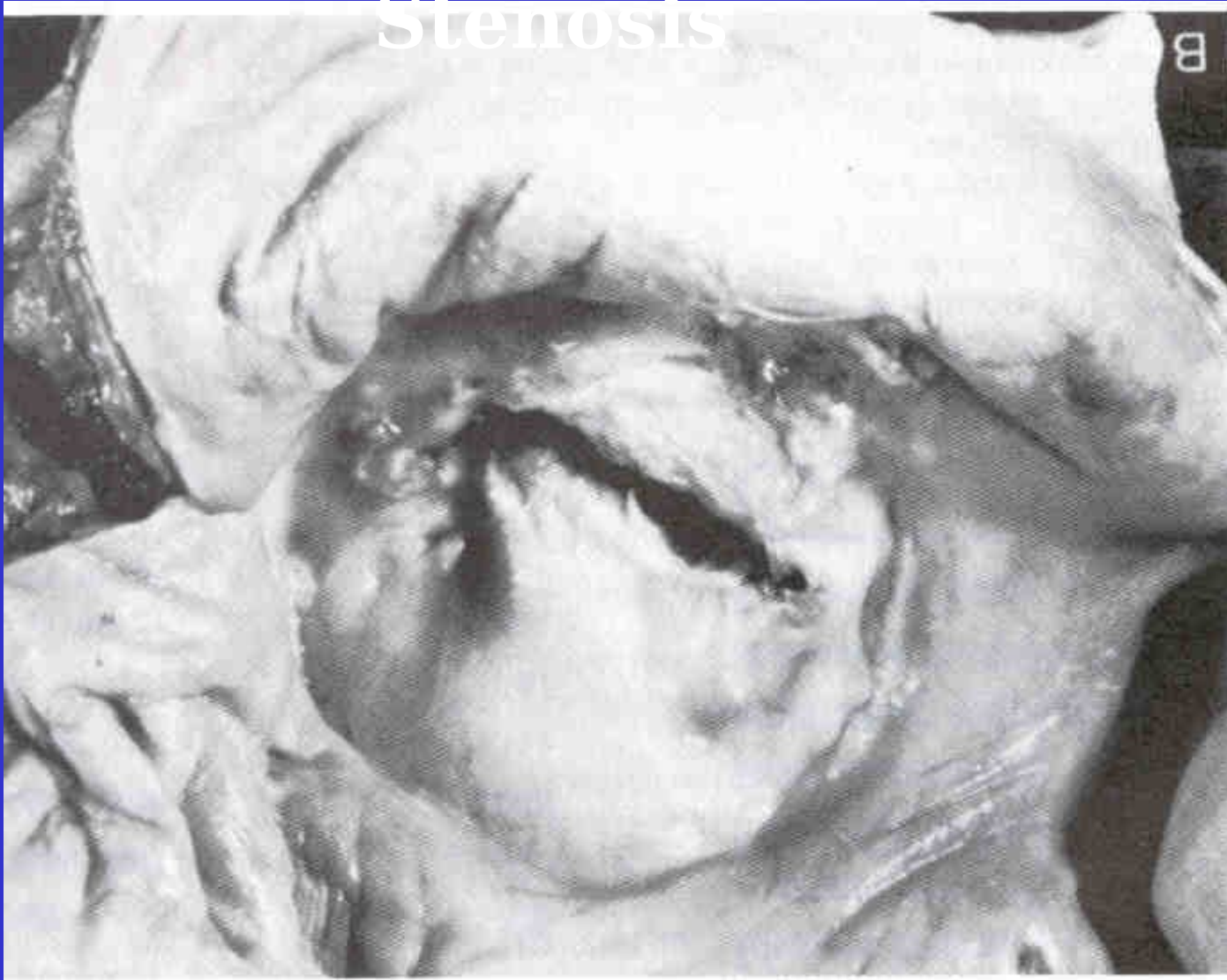


# Symptomatic AS- management

- NO SAFE MEDICAL RX for Severe AS
- Physical diagnosis straight forward
- systolic crescendo-decrescendo murmur
  - loudest in aortic area usually (sometimes apex)
  - radiates to carotids
- LV hypertrophy associated with gallop (S4)
- Signs of critical AS
  - carotid upstrokes small and delayed in severe AS
  - loss of aortic component of S2
  - late peaking murmur



# Mitral Stenosis







# Mitral Stenosis

- Almost always rheumatic in origin
- Murmur may be subtle, but high flow states cause increased pressure gradient, pulmonary edema
  - classic presentation is during vaginal delivery. Tachycardia, straining, volume increase cause pulmonary edema
- Patients eventually have exertional dyspnea, atrial fibrillation (often with thromboembolism), chest pain

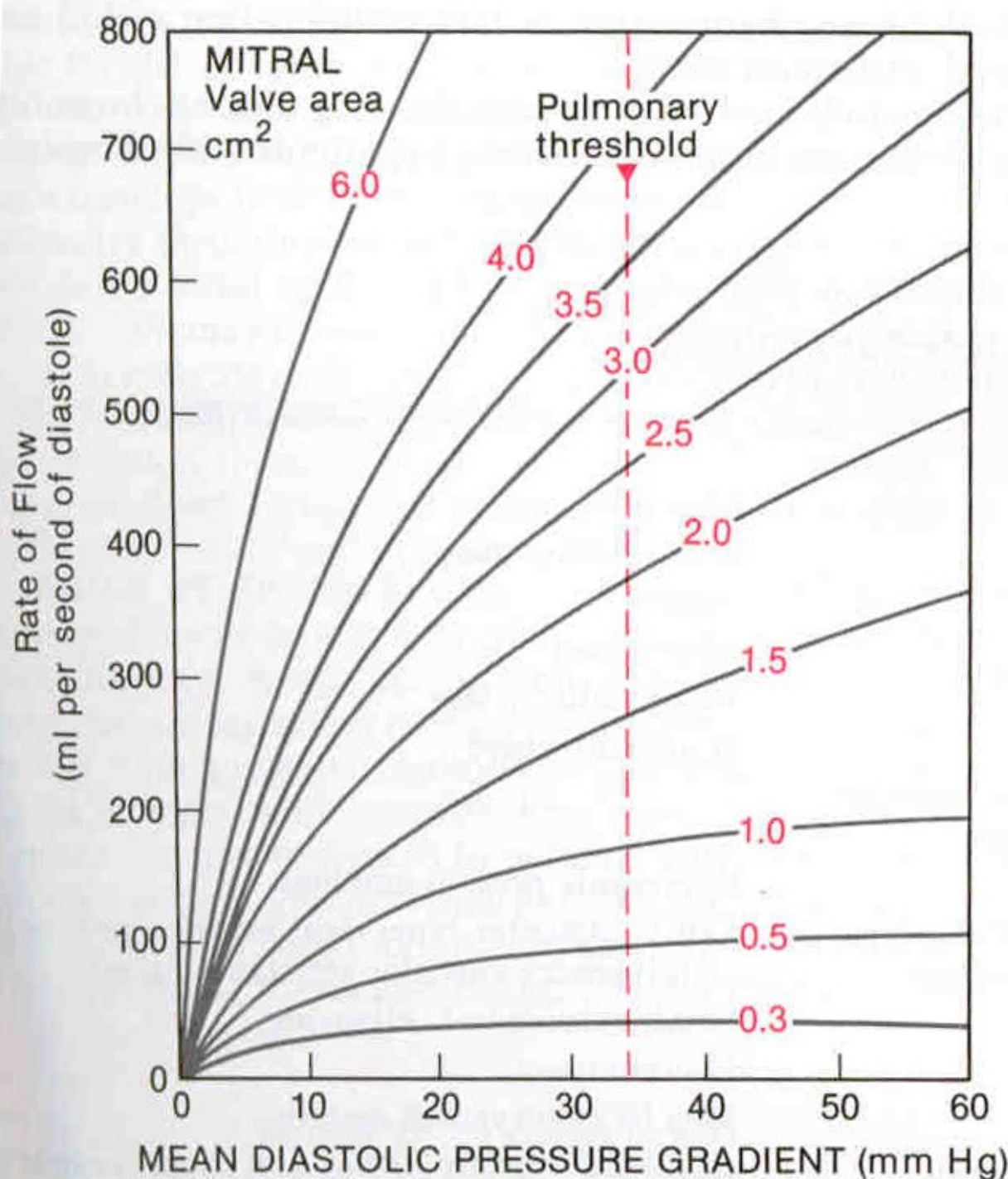


**Normal MVA 4-5 cm<sup>2</sup>**

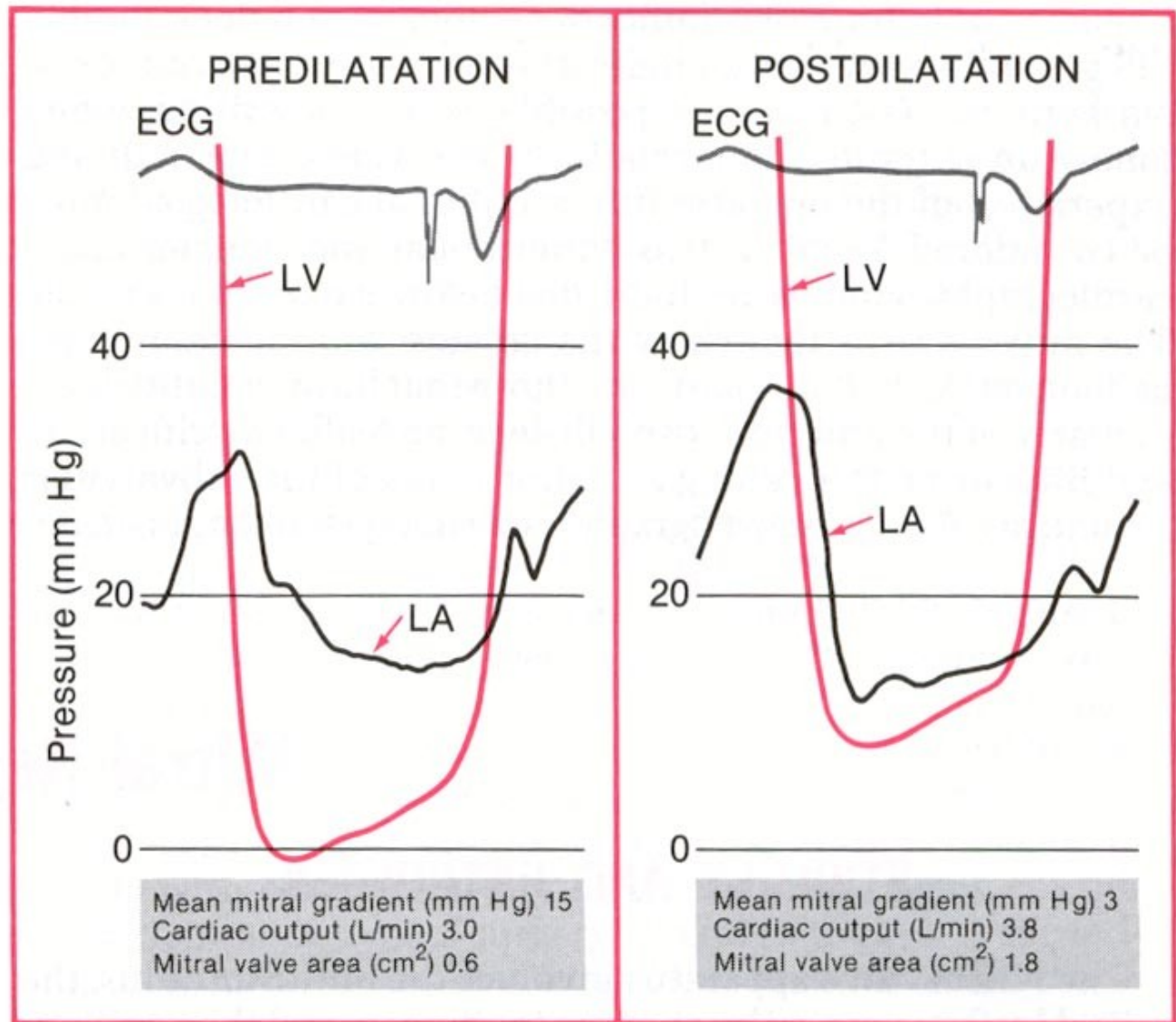
**>2.5 cm<sup>2</sup>  
asymptomatic**

**<1.5 cm<sup>2</sup> may  
have sx's at rest**

**Stress which  
increases  
transmitral flow  
or decreases  
diastolic filling  
time will  
significantly  
increase gradient**



MS causes high pressure in LA, low pressure in LV, so poor LV diastolic filling and backward failure symptoms of pulmonary edema, atrial fibrillation, and thromboembolism. Surgery here



**FIGURE 34-8.** Simultaneous left atrial (LA) and left ventricular (LV) pressure before and after balloon valvuloplasty of the mitral valve in a patient with severe mitral stenosis. (Courtesy of Raymond G. McKay, M.D.)

# Mitral Stenosis

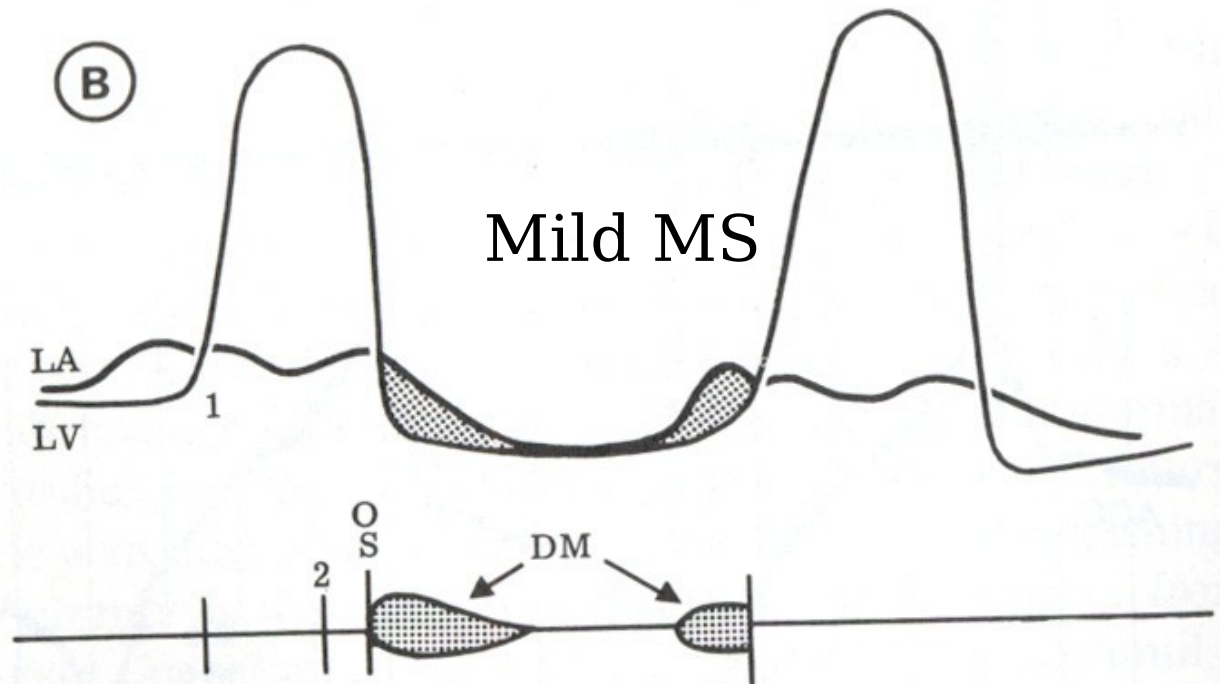
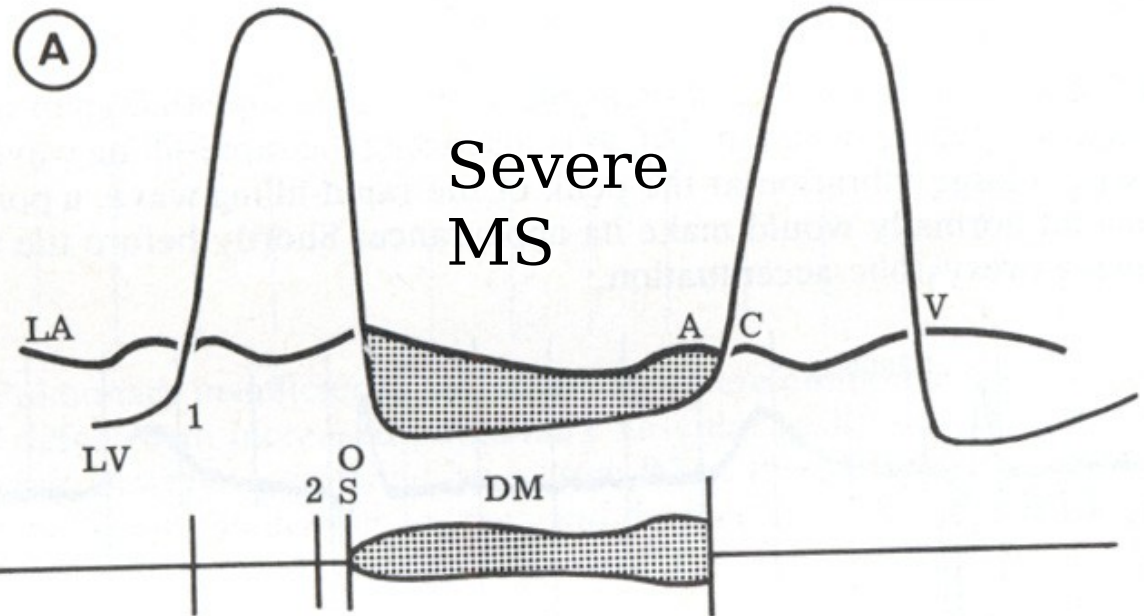
- Turbulent, high velocity flow occurs during diastole
  - murmur is therefore a DIASTOLIC, low frequency rumble heard at apex with stethoscope bell, patient in L lateral decubitus
  - requires quiet concentration, palpate carotid to time systole/diastole
- Always look for MS in patient with new Atrial fibrillation
  - rate control, anticoagulation crucial



# MS Murmur

**Severe MS**  
associated with pan-diastolic rumble,  
short S2-OS interval.

**Mild MS (B)**  
associated with decrescend  
o-crescendo rumble,  
longer S2-OS interval





# MS Mortality

- Minimal sx's >80% 10 year survival
- Limiting sx's, <15% 10 year survival
- Untreated patients
  - 60-70% progressive pulmonary edema
  - 20-30% systemic embolism
  - 10% pulmonary embolism
  - 1-5% endocarditis/infection

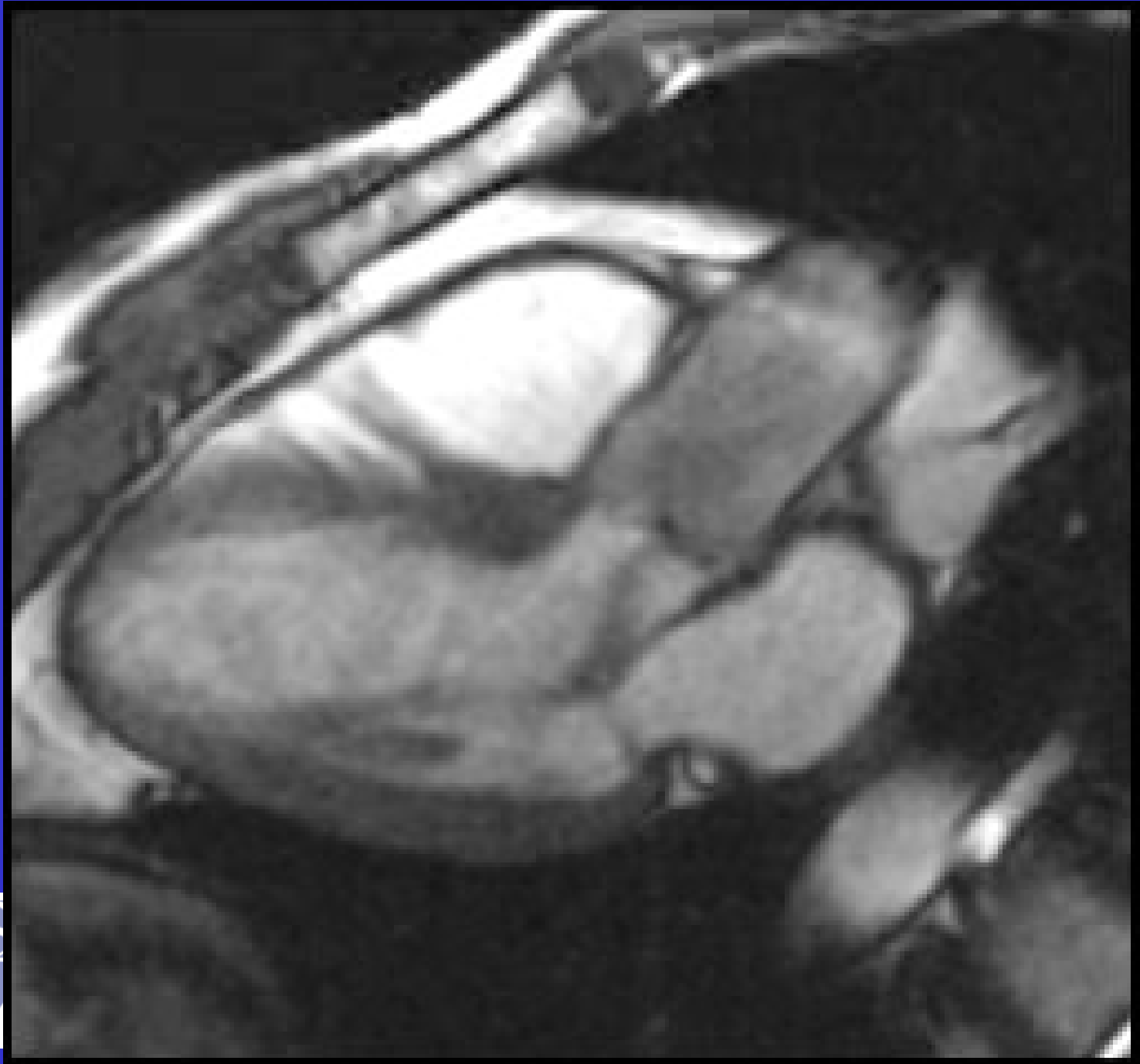


# Aortic Regurgitation

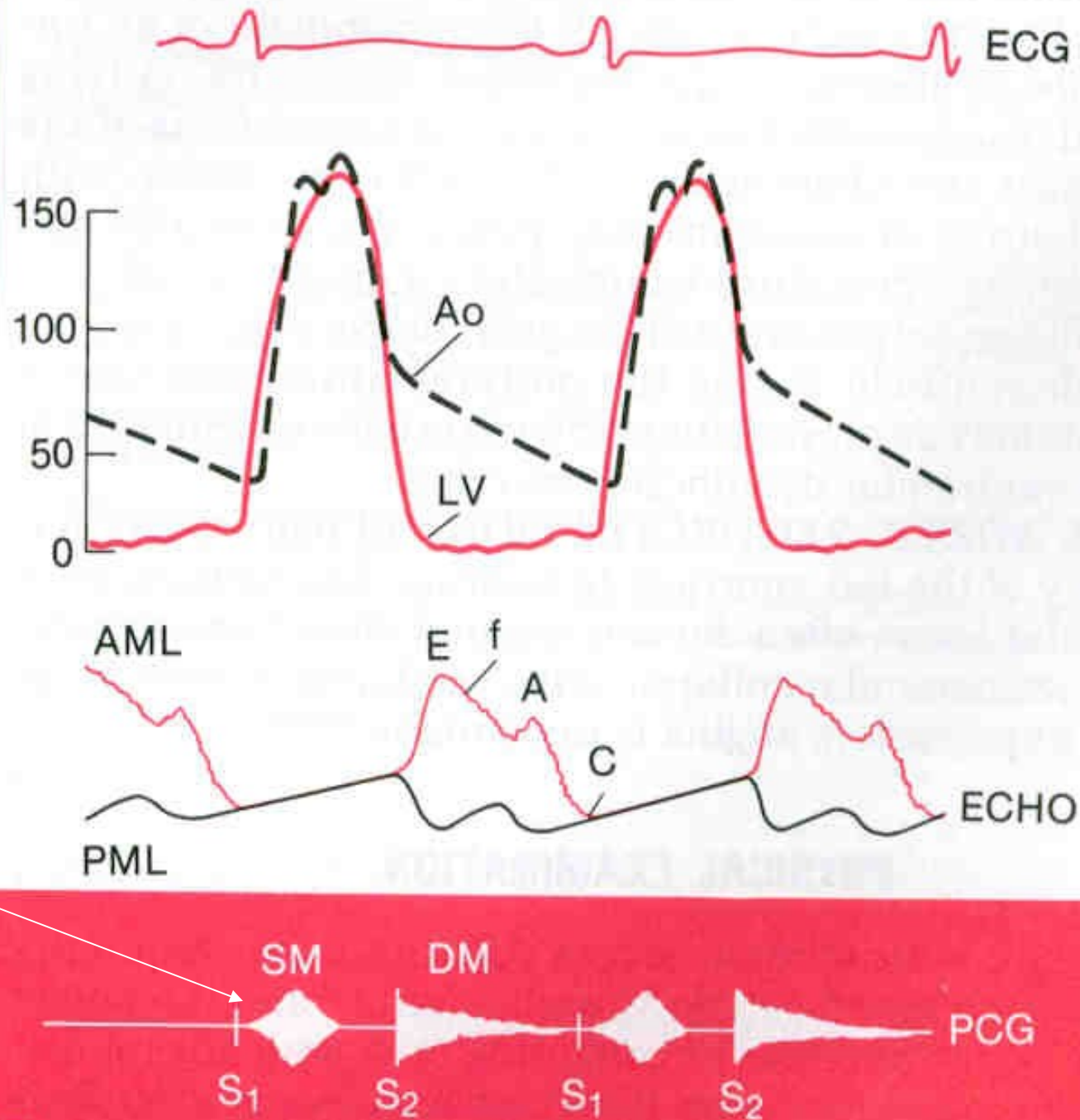
- Loss of cardiac output backwards from aorta into LV
- congenital, endocarditis, age, aortic disease, collagen vascular, syphilis
- Early diastolic, decrescendo murmur best heard at LLSB with diaphragm
  - subtle, have pt lean forward, breathe out
  - associated with wide pulse pressure



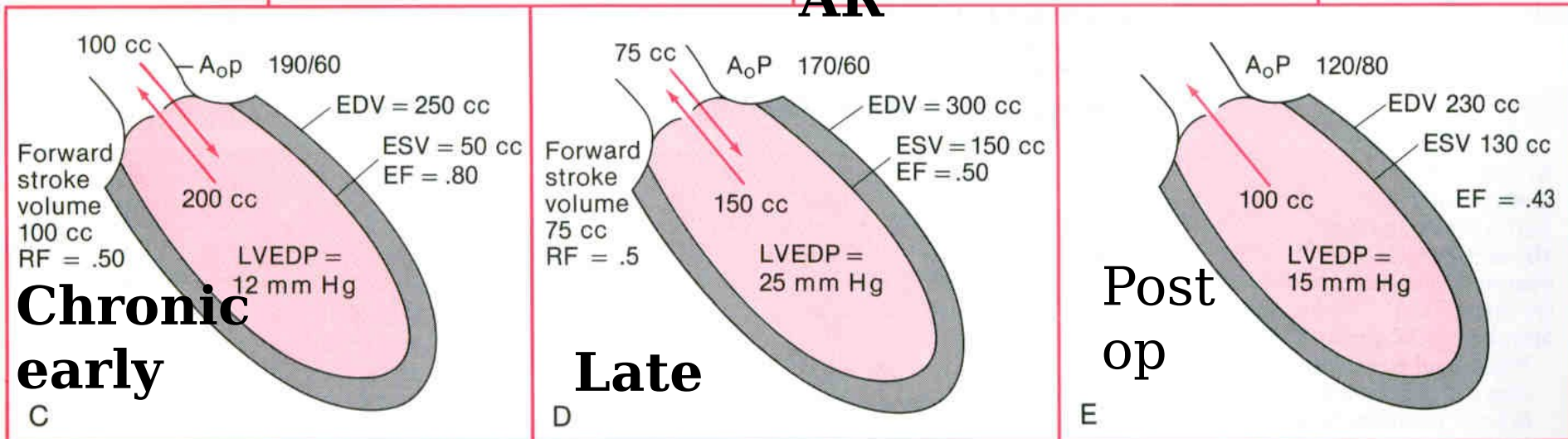
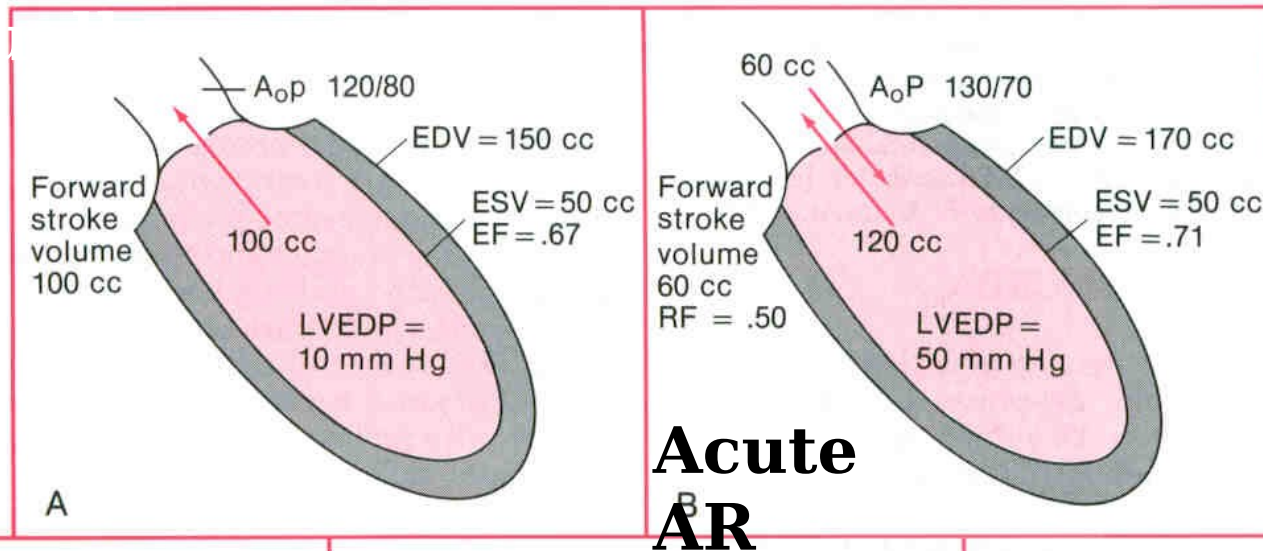




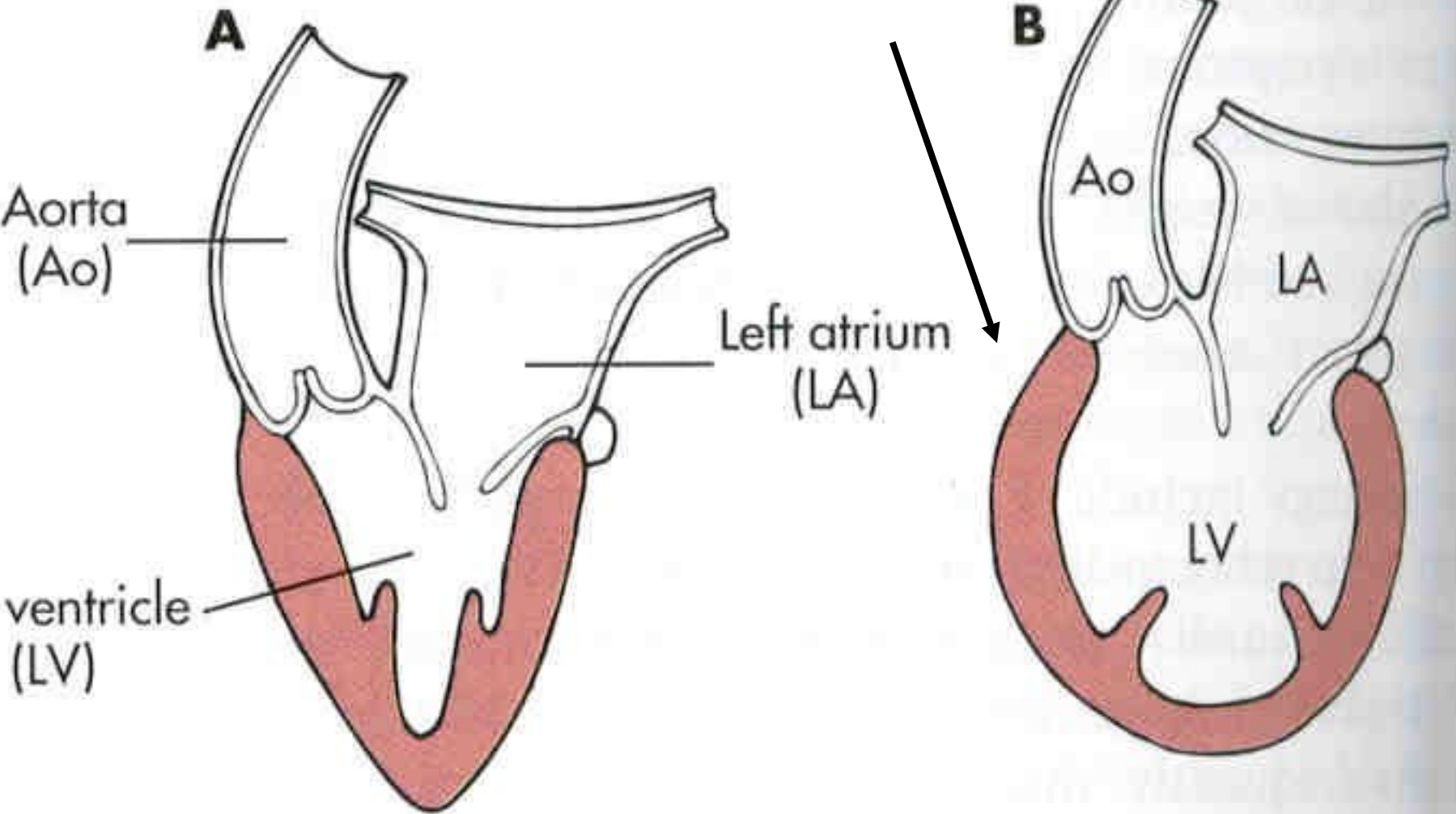
**Chronic AR**  
**Early diastolic**  
**decrecendo**  
**murmur at**  
**time of**  
**greatest**  
**pressure**  
**difference**  
**between Ao**  
**and LV. Note**  
**early systolic**  
**flow murmur.**



**Acute AR causes sudden increase in LVEDP, pulmonary edema. Over time, eccentric hypertrophy allows LV to accommodate increased volume, but ventricle fails**

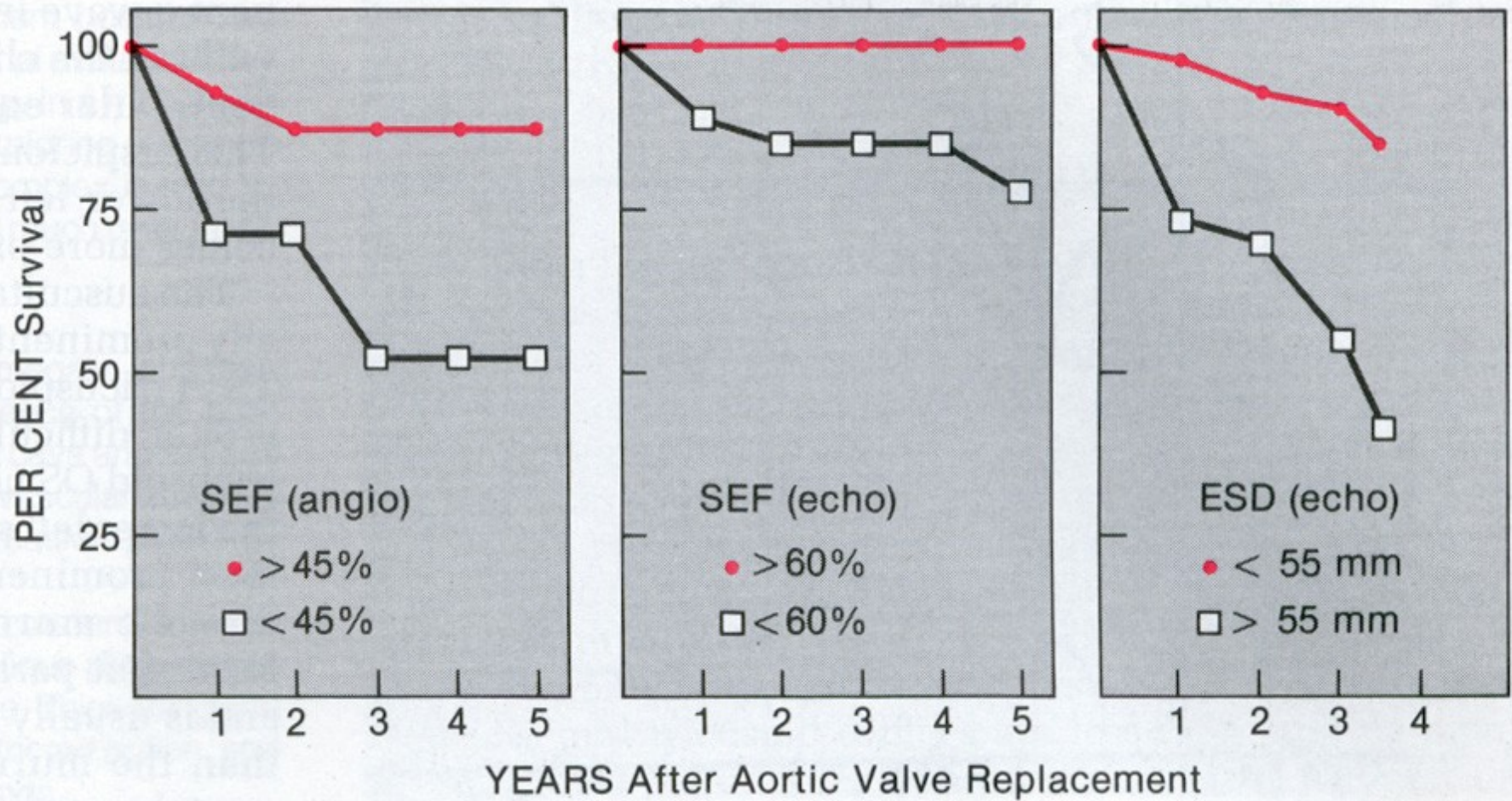


# Effect of volume overload





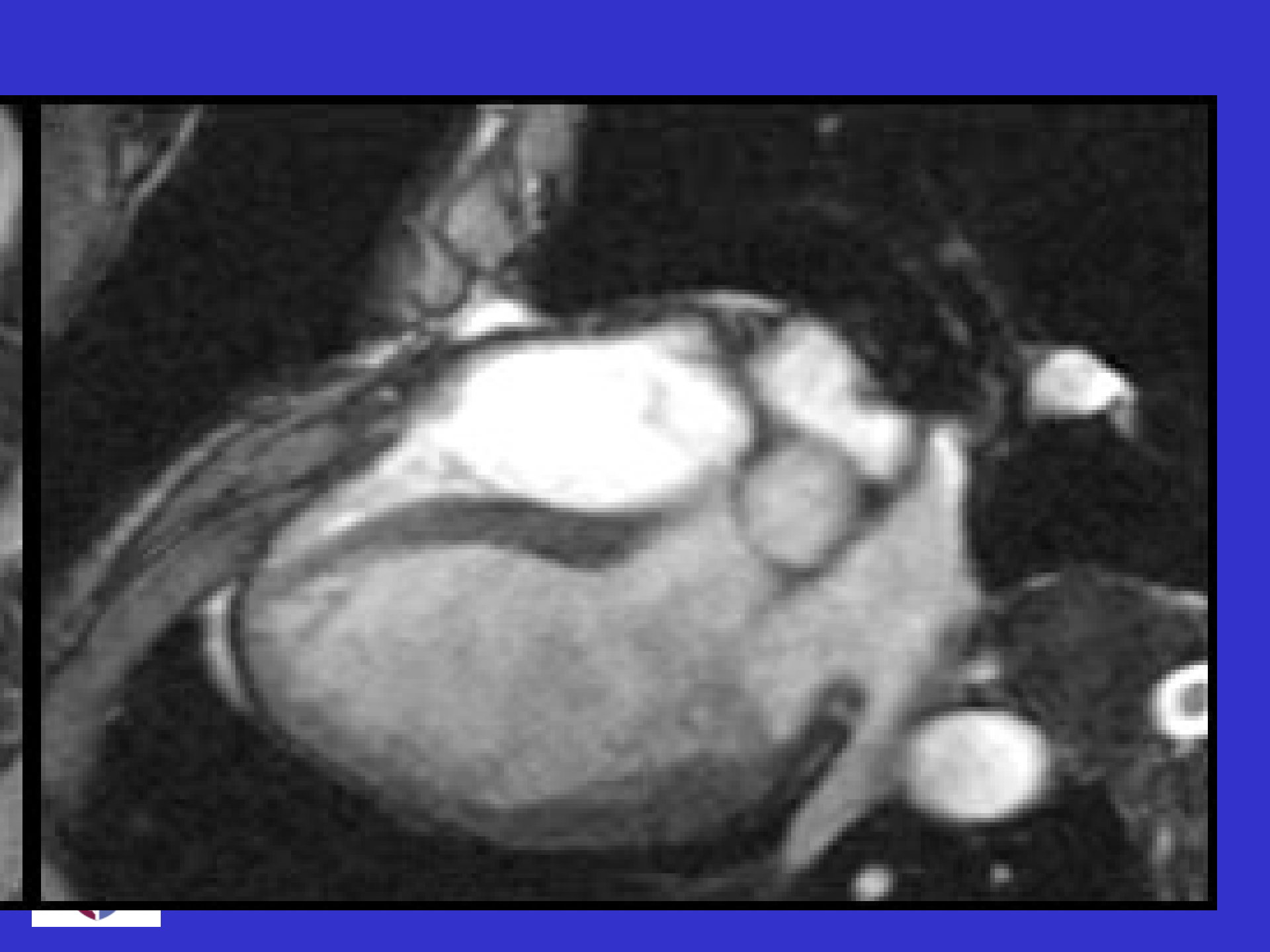
# Survival post AV replacement for Aortic Regurgitation based on Pre-op Systolic function



# Mitral Regurgitation

- Incompetent mitral valve allows loss of stroke volume back into LA
- Mitral valve prolapse most common cause
  - rheumatic disease and endocarditis
- PE much less subtle than MS
  - loud pan-SYSTOLIC murmur, loudest at apex and radiating into axilla
  - typically soft S1
  - S2 obscured by murmur
  - presence of S3 suggests severe MR



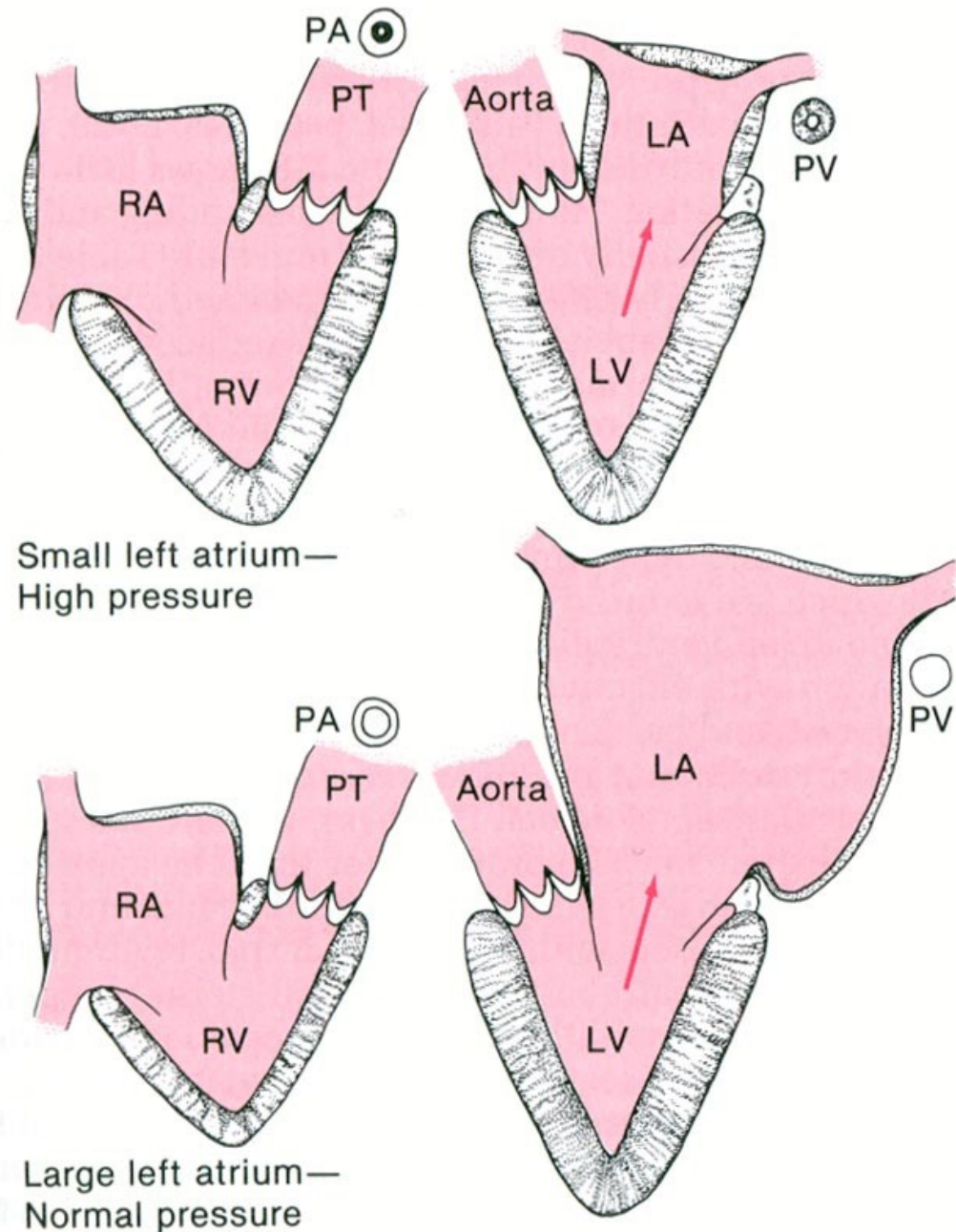


**Acute MR** causes  
immediate  
pulmonary edema,  
often fatal  
post infarction,  
acute  
endocarditis,  
chord rupture

**Chronic MR** causes  
LA enlargement,  
eventual LV  
dilatation and  
failure.

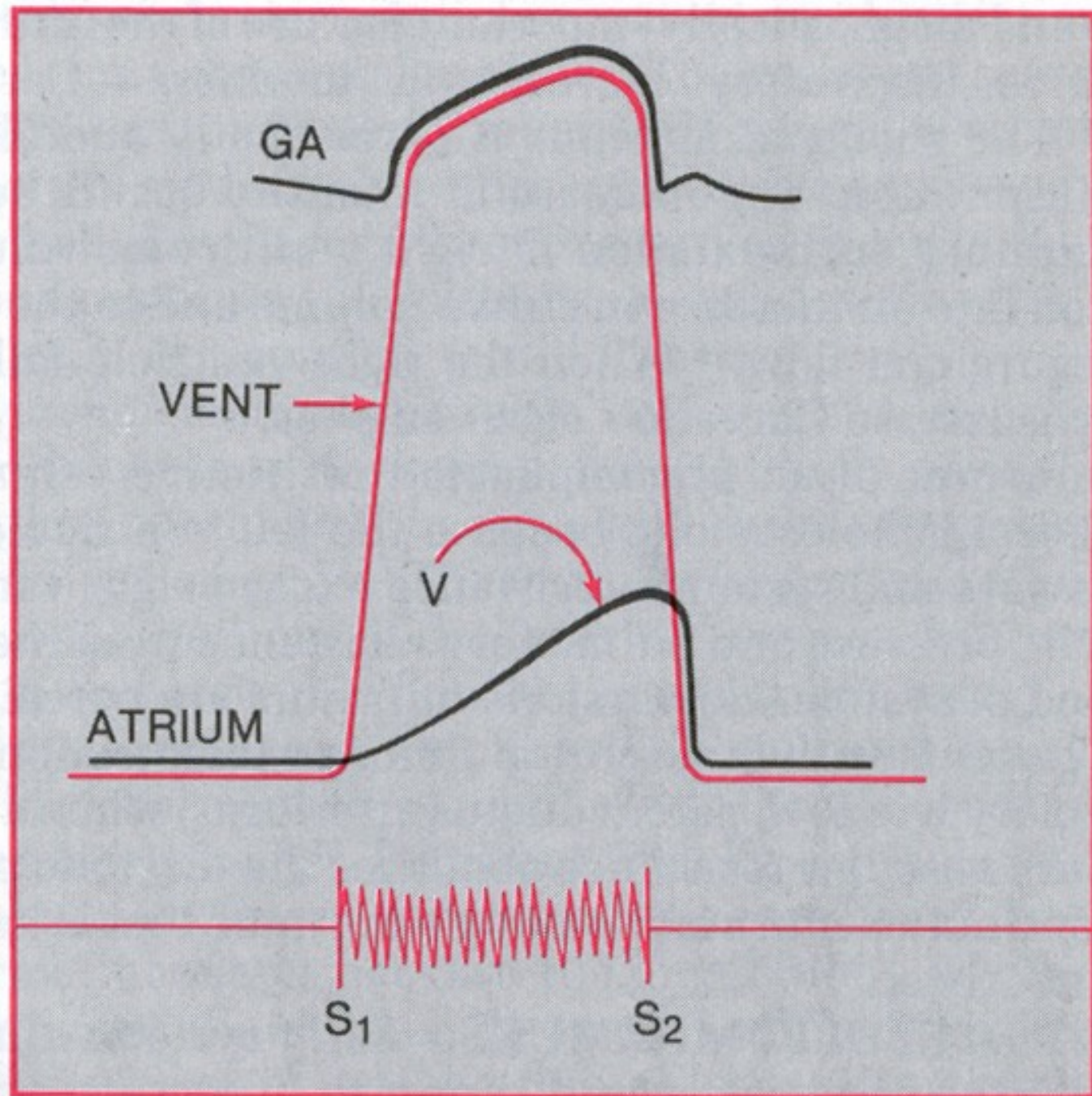


## THE SYNDROME OF MITRAL REGURGITATION

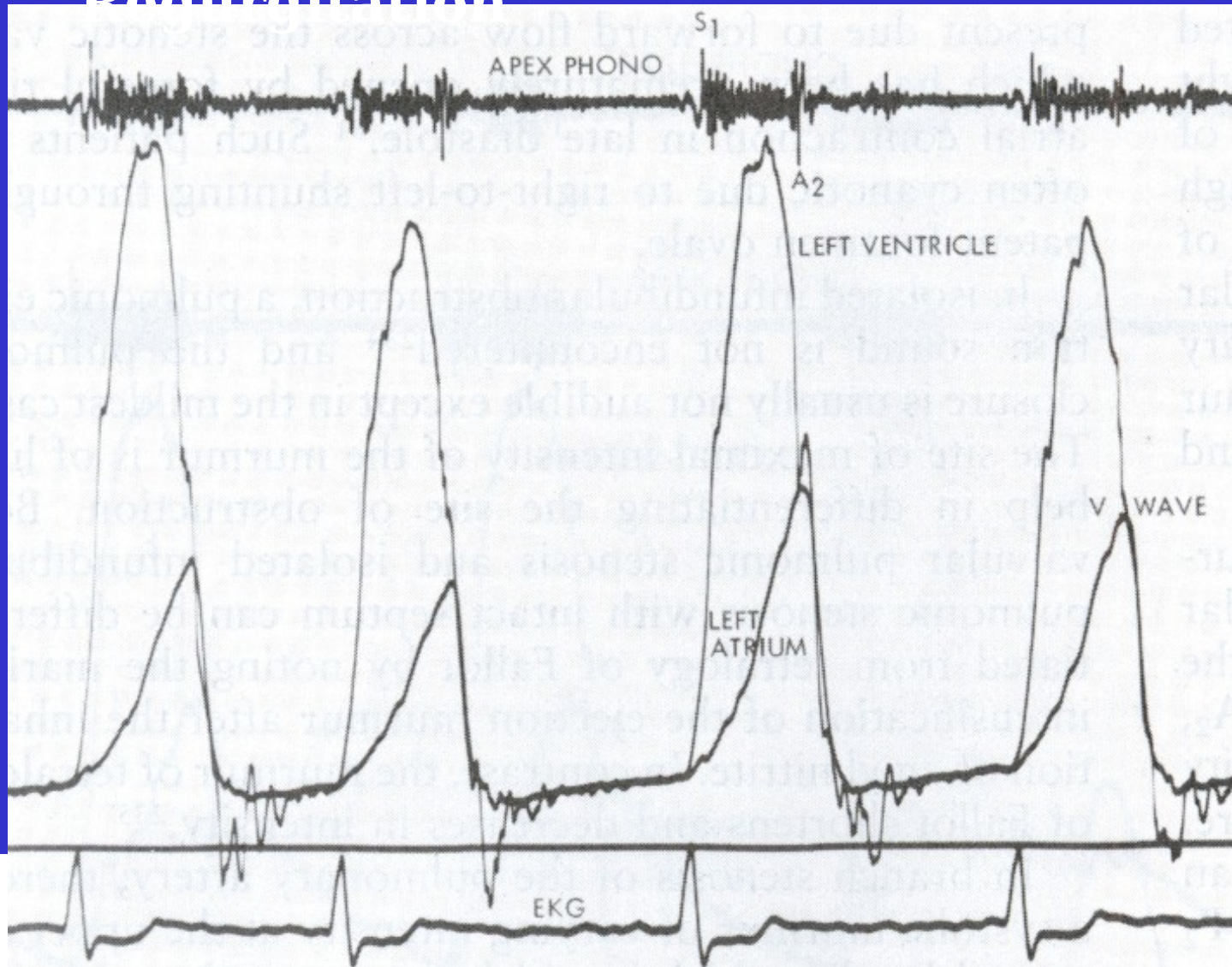




**Murmur in  
MR Note  
Holosystolic  
nature-  
begins with  
S1 and ends  
at S2 (often  
goes  
beyond S2).**



# Pansystolic Murmur, LV and LA pressures during Chronic Mitral Regurgitation

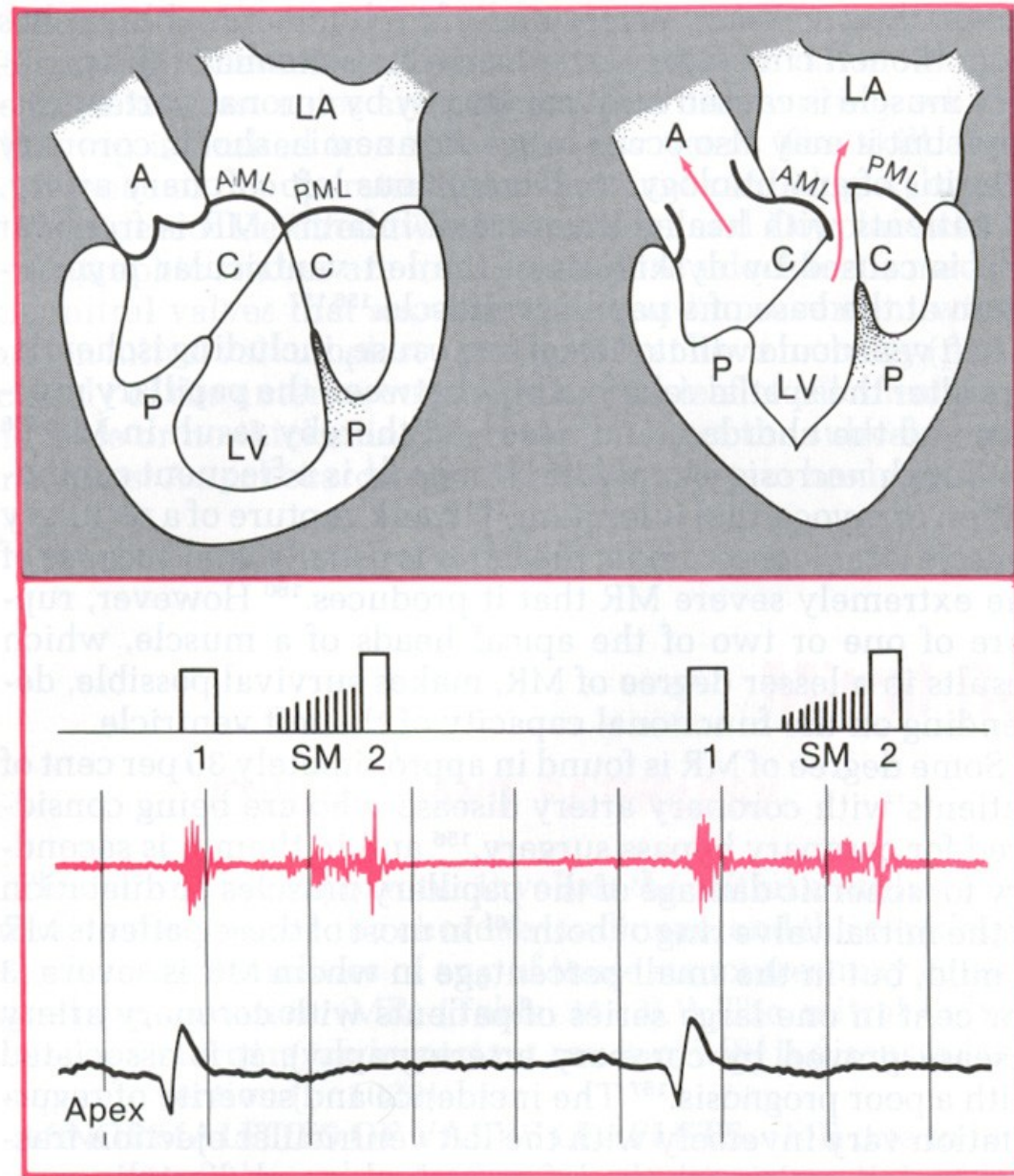




**Mitral Valve  
Prolapse causes  
regurgitation due  
to mismatch of MV  
leaflets. Note  
crescendo murmur.**

**Most common form  
of valvular HDz- 2-  
6% of population.**

**Life expectancy is  
normal except in  
significant MR,  
severely thickened  
leaflets, enlarged  
LA especially  
men > 45**



# MR Treatment

- No medical therapy
- Most difficult clinically
  - By the time symptoms occur, it may be too late
- Drop in EF or development of atrial fibrillation enough to justify surgery



# Valvular Disease

## General Principles

- Left sided valvular disease more prone to cause serious hemodynamic problems
- regurgitation causes volume overload- eccentric hypertrophy (dilatation)
- stenotic lesions cause pressure overload on proximal chamber- concentric hypertrophy (thickened walls)
- stenotic lesions cause symptoms **sooner** than regurgitant lesions but respond to therapy better



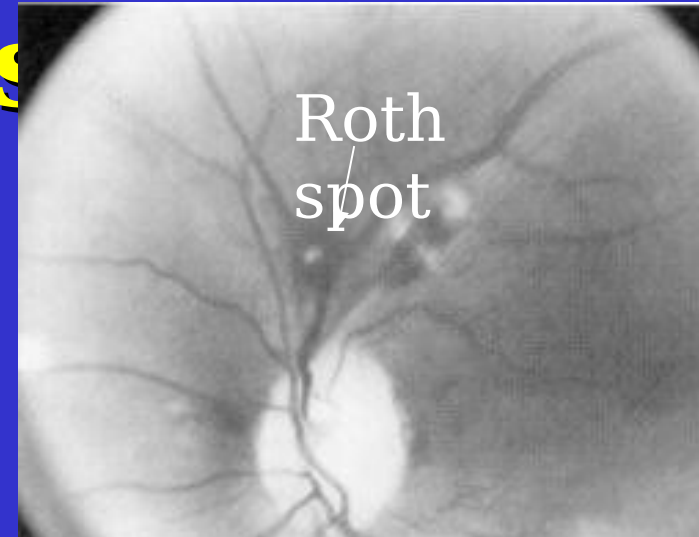
# Valvular Disease

- Rheumatic fever
  - regurgitation frequently present *acutely*
  - long term predominant effect is stenosis
- Endocarditis causes regurgitation
  - patients with valve dz should take antibiotics prior to dental work to prevent endocarditis
- All patients with symptomatic valvular disease (i.e. dyspnea, chest pain, syncope) need to be evaluated for surgical correction
  - Some asymptomatic subjects also need correction “before it’s too late”



# Endocarditis

- **Etiology**
  - damaged valve (RHD) exposed to bacteria in blood stream
  - *S. viridans*, *S. aureus*
- **Clinical**
  - acute, subacute, chronic
  - fever, murmur, ESR
  - (+) blood cultures
- **Treatment**
  - antibiotic according to organism
  - future prophylaxis for procedures



# Conclusions

- Valvular heart disease associated with spectrum of presentations
- Recognition prior to the onset of symptoms may be life saving
- Careful physical exam almost always diagnostic





# “Pearls”

- Diastolic murmurs usually represent pathological conditions as do most continuous murmurs.
- Most important issue in patient with a cardiac murmur is the presence or absence of symptoms.
  - Many asymptomatic children and young adults with grade 2/6 midsystolic murmurs and no other cardiac physical findings need no further cardiac evaluation
  - ***Many asymptomatic*** elderly patients have midsystolic murmurs related to sclerotic aortic valve leaflets, flow into tortuous, noncompliant great vessels
  - Such murmurs must be distinguished from murmurs caused by mild to severe valvular aortic stenosis (AS) which is prevalent in this age group.



***Circulation. 1998;98:1949-198***

# **Recommendations for Echocardiography in Asymptomatic Patients With Cardiac Murmurs**

- **1. Diastolic or continuous murmurs. Class I**
- **2. Holosystolic or late systolic murmurs. I**
- **3. Grade 3 or greater midsystolic murmurs. I**
- **4. Murmurs associated with abnormal physical findings**
  - **on cardiac palpation or auscultation. IIa**
- **5. Murmurs associated with an abnormal ECG or chest**
  - **x-ray. IIa**



*Circulation.*  
**1998;98:1949-1984.**

# Class III Indications for Echo

- **6. Grade 2 or softer midsystolic murmur identified as innocent or functional by an experienced observer. III**
- **7. To detect “silent” aortic regurgitation or mitral regurgitation in patients without cardiac murmurs, then recommend endocarditis prophylaxis. III**  
*Circulation. 1998;98:1949-1*



# **Recommendations for Echocardiography in Symptomatic Patients With Cardiac Murmurs**

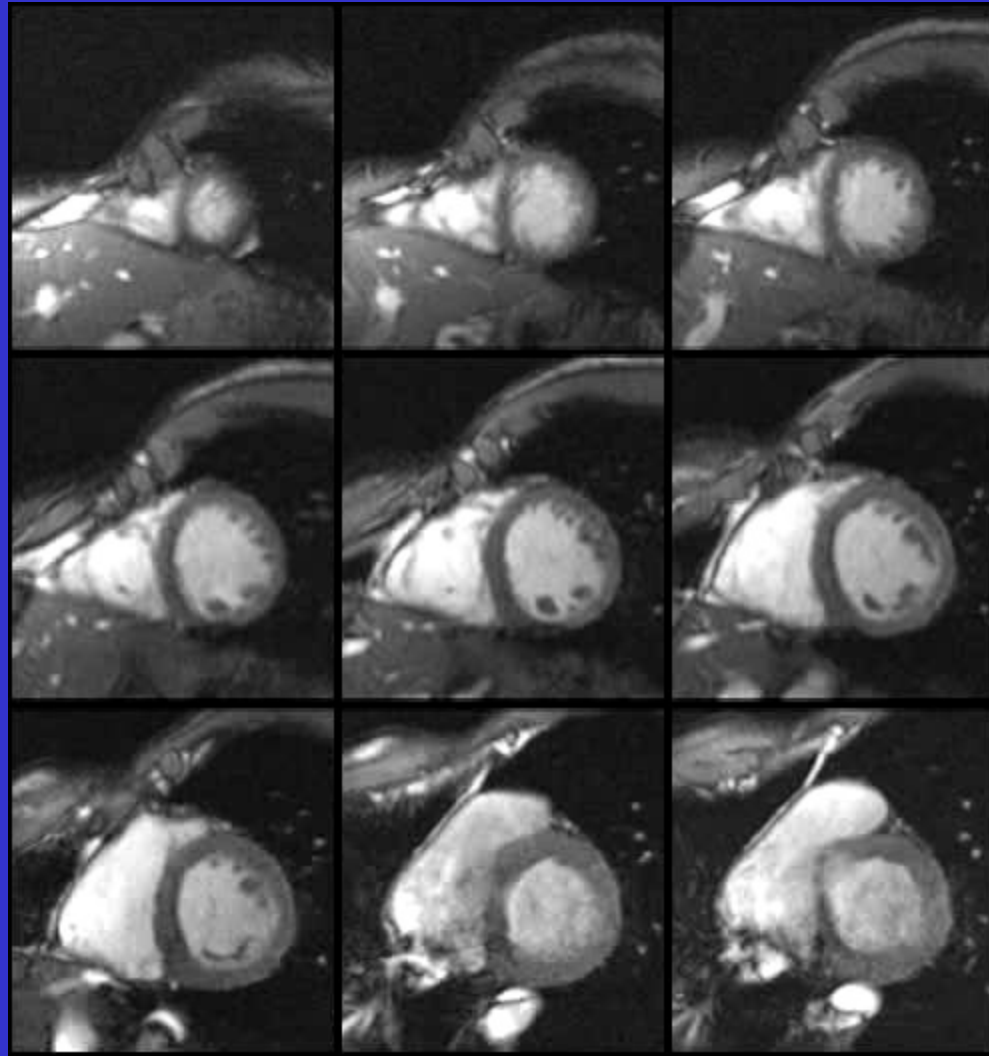
- **1. Symptoms or signs of congestive heart failure, myocardial ischemia, or syncope. I**
- **2. Symptoms or signs consistent with infective endocarditis or thromboembolism. I**
- **3. Symptoms or signs likely due to noncardiac disease  
with cardiac disease not excluded by standard cardiovascular evaluation. IIa**
- **4. Symptoms or signs of noncardiac disease with an  
isolated midsystolic “innocent” murmur. III**

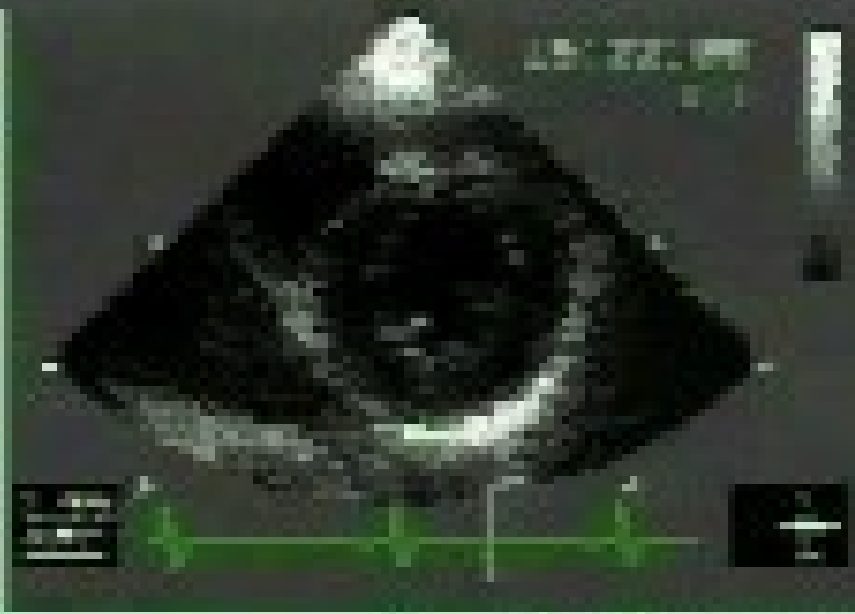


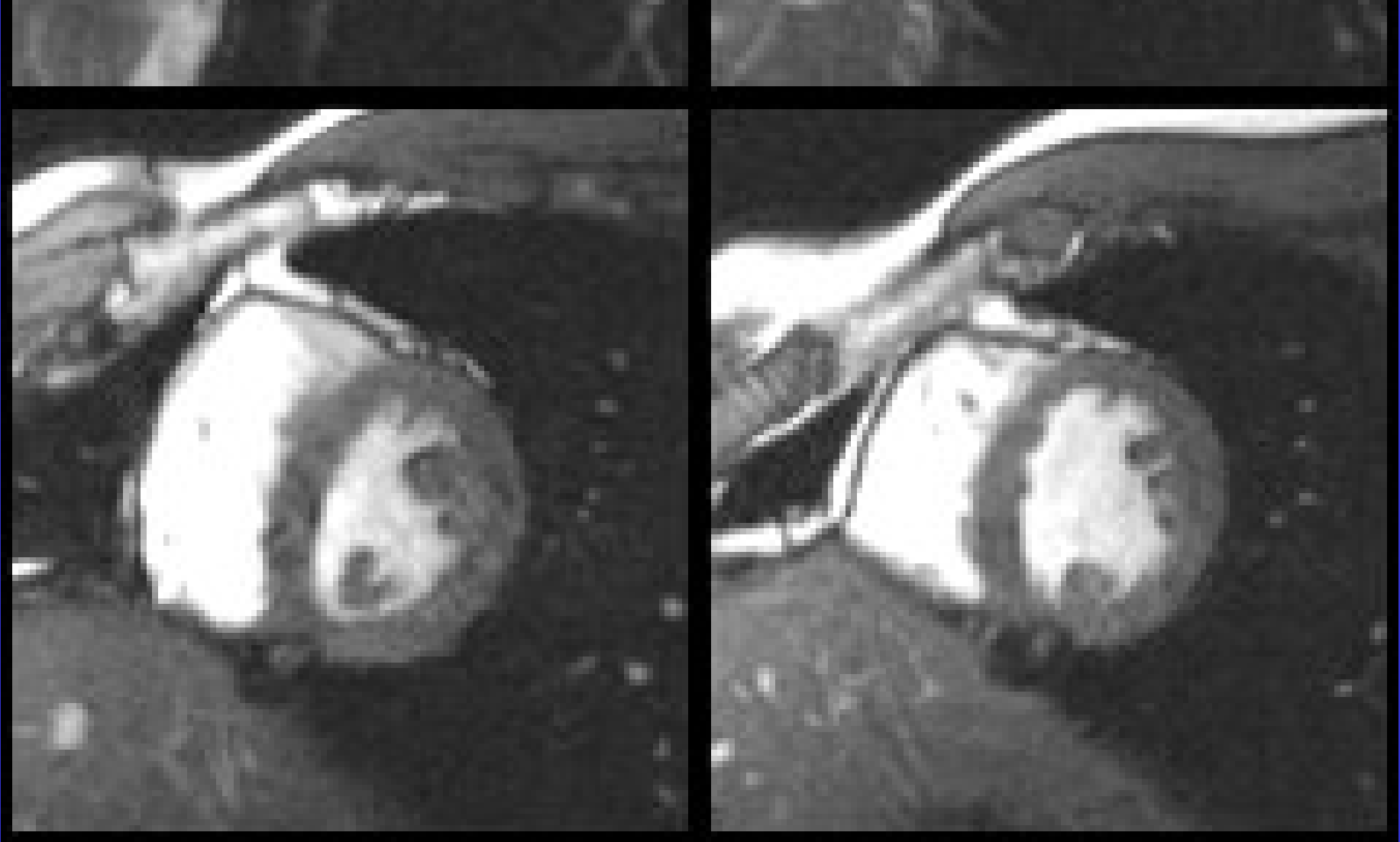






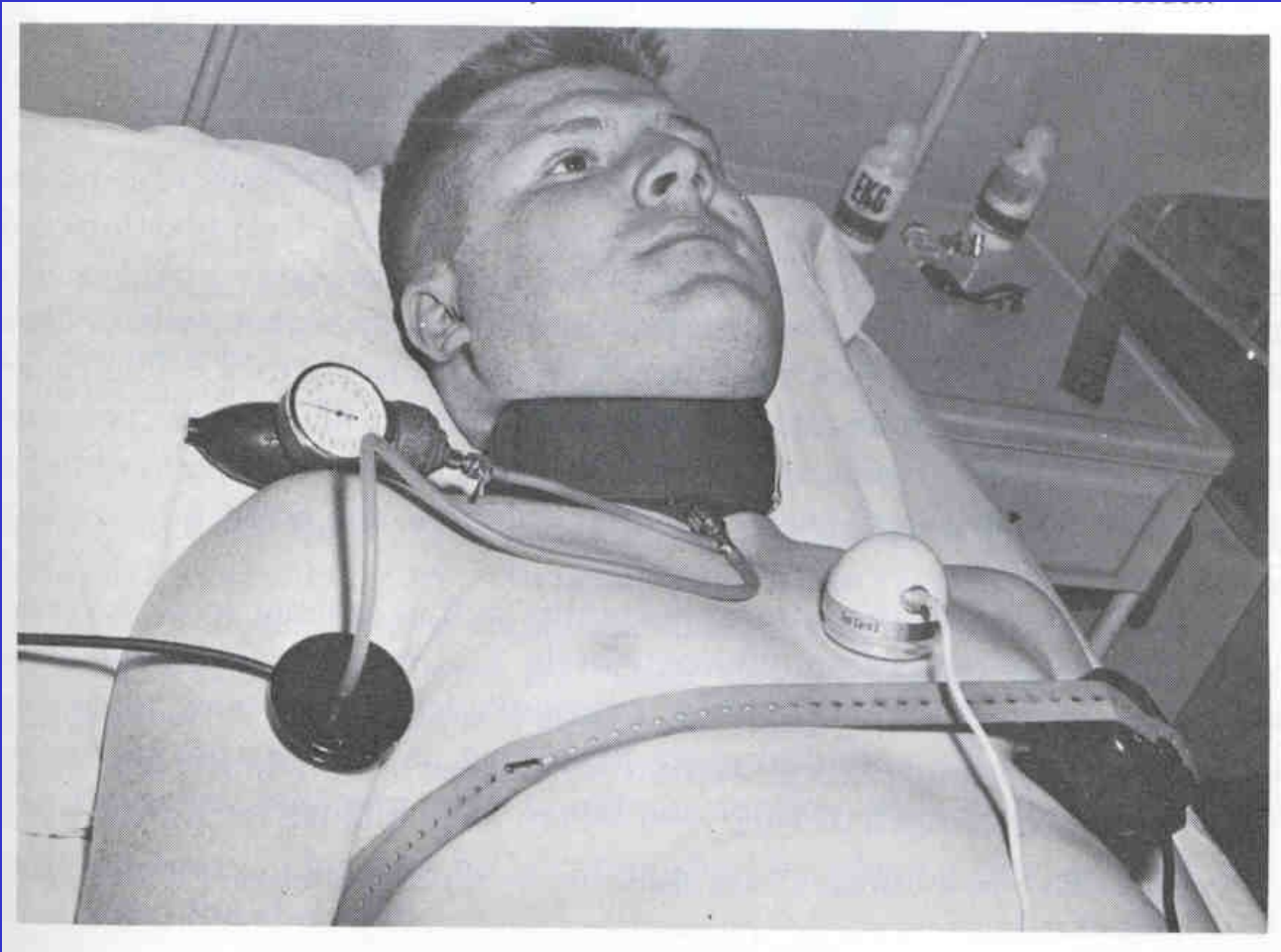




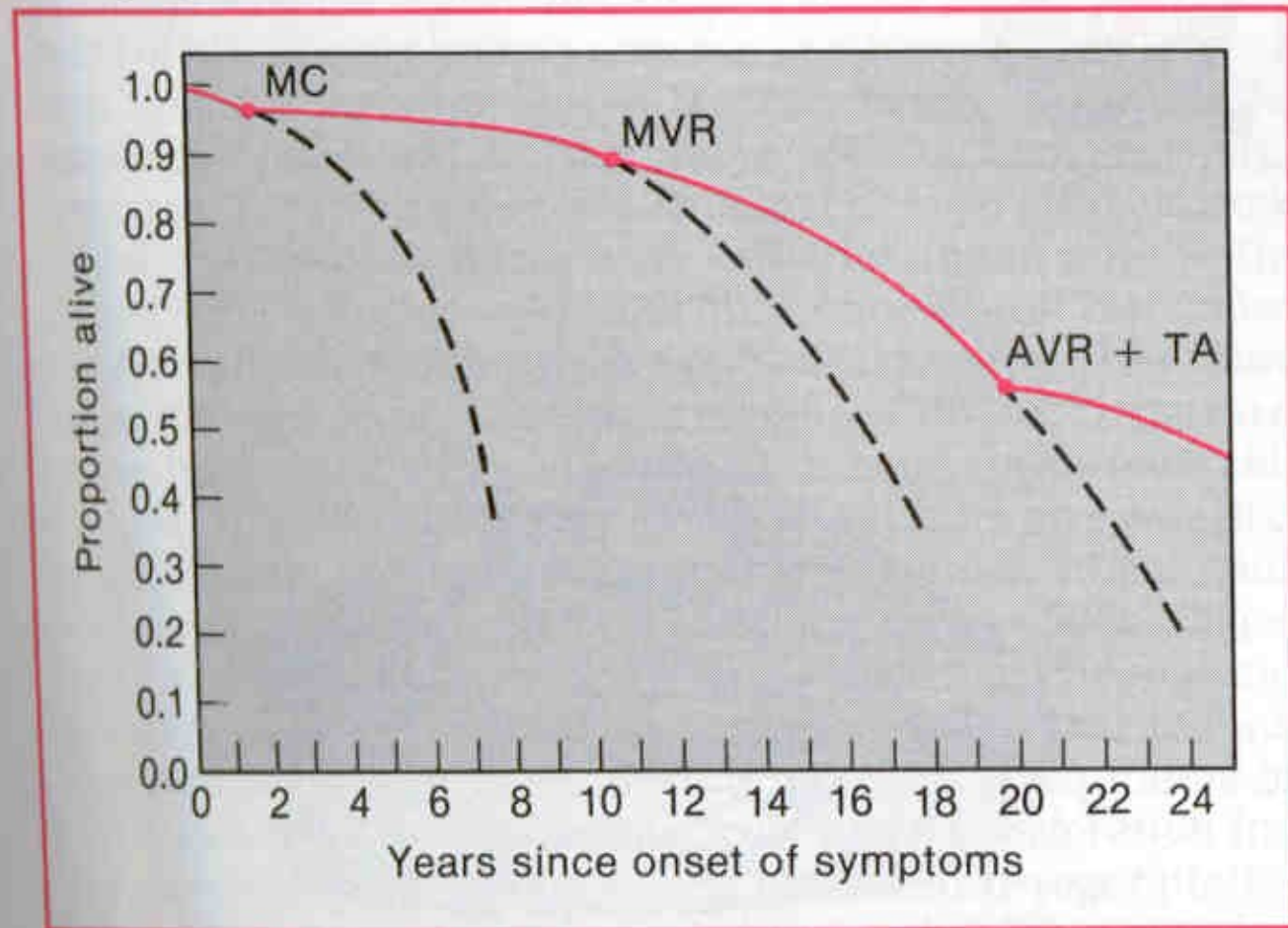


Glockner, et al. *Radiographics*.  
2003;23:e9-e9.

# Valvular Heart Disease



the asymptomatic or minimally symptomatic frequency of



**FIGURE 34-6.** Schematic representation of the subsequent life history after the initial development of symptoms in a large group of patients with mitral stenosis. The red solid circles and red lines indicate a surgical procedure. The dashed lines represent estimated survival of patients not receiving the surgical procedure. MC = mitral commissurotomy, MVR = mitral valve replacement, TA = tricuspid annuloplasty, AVR = aortic valve replacement. (From Kirklin, J. W., and Barratt-Boyes, B. G.: Cardiac Surgery. New York, John Wiley and Sons, 1986, p. 328.)

